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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/662,845	09/15/2003	Ming-Fang Wang	67,200-908	1193
47390	7590	10/03/2005	EXAMINER	
THOMAS, KAYDEN, HOSTEMEYER & RISLEY LLP 100 GALLERIA PARKWAY SUITE 1750 ATLANTA, GA 30339			NGUYEN, CUONG QUANG	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 10/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/662,845

Applicant(s)

WANG ET AL. 

Examiner

Cuong Q. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-32 is/are pending in the application.
- 4a) Of the above claim(s) 2-4 and 13-32 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 and 5-12 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

## **DETAILED ACTION**

### **Claim Rejections - 35 USC § 103**

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 5, 6, 7, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hegde et al. (US 6,717,226) in view of Gardner (US 6,020,260).

Regarding claims 1, 5, 8, Hegde et al. et al. discloses a method for forming a gate stack having improved electrical properties in a gate structure forming process comprising the steps of: providing a semiconductor substrate (12); forming a metal oxide layer (26) (a HfO<sub>2</sub> layer with a dielectric constant of greater than about 20. Col.2 lines 40-51) over an exposed portion of the semiconductor substrate; and, forming a layer of electrode (a polysilicon layer 16) (col.2 lines 5-6) over the metal oxide layer. See Fig.1 and Fig.2.

Hegde et al. does not explicitly teach that the polysilicon electrode is formed in a nitrogen containing ambient.

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Gardner teaches that a polysilicon gate electrode (300) is formed in a nitrogen containing ambient. See col.2 lines 34-41.

It would have been obvious to one of ordinary skill in the art to form the gate electrode in a nitrogen containing ambient as taught by Gardner in Hegde et al.'s device in order to enhance the performance of the semiconductor device. See Gardner's col.2 lines 30-33.

Regarding claims 6 and 7, Hegde et al. teaches that metal oxide layer is formed of HfO<sub>2</sub> having a dielectric constant of greater than about 20 and having a thickness about 20 angstroms (it is noted that the HfO<sub>2</sub> with the thickness of about 20 angstrom has a dielectric thickness equivalent to a silicon dioxide dielectric thickness of less than about 20 Angstroms). Col.3 lines 12-15.

Regarding claim 9, Hegde et al. teaches that the metal oxide is formed of an atomic layer deposition (ALD) method. Col.2 lines 64-67.

Claims 1, 5-7, 8-9, and 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paton et al. (US 6,682,973) in view of Gardner (US 6,020,260).

Regarding claims 1, 5, 8, Paton al. et al. discloses a method for forming a gate stack having improved electrical properties in a gate structure forming process comprising the steps of: providing a semiconductor substrate (16); forming a metal oxide layer (28) (a HfO<sub>2</sub> layer with a dielectric constant of greater than about 20. See TABLE 1) over an exposed portion of the semiconductor substrate; and, forming a layer of

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electrode (a polysilicon layer 16) (col.6 lines 40-45) over the metal oxide layer. See Fig.1.

Paton et al. does not explicitly teach that the polysilicon electrode is formed in a nitrogen containing ambient.

Gardner teaches that a polysilicon gate electrode (300) is formed in a nitrogen containing ambient. See col.2 lines 34-41.

It would have been obvious to one of ordinary skill in the art to form the gate electrode in a nitrogen containing ambient as taught by Gardner in Paton et al.'s device in order to enhance the performance of the semiconductor device. See Gardner's col.2 lines 30-33.

Regarding claims 6 and 7, Paton et al. teaches that metal oxide layer is formed of  $\text{HfO}_2$  having a dielectric constant of 40 and having a thickness about 100 has a dielectric thickness equivalent to a silicon dioxide dielectric thickness of less than about 10 Angstroms. Col.4 lines 17-25.

Regarding claim 9, Paton et al. teaches that the metal oxide is formed of an atomic layer deposition (ALD) method. Col.10 lines 50-55.

Regarding claim 11, Paton et al. further teaches that an aluminum oxide layer (30) is formed over the metal oxide layer. See col.60-65.

Regarding claim 12, Paton et al. teaches that layer (30) having a thickness in the range of 1 angstrom to about 20 angstroms. See Paton et al.'s col.12 lines 35-40.

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Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hegde et al. in view of Gardner and further in view of Yu et al. (US 6,573,193).

The combination of Hegde et al. and Gardner teaches all the limitations of claim 9 as shown above. However, this combination does not explicitly teach that an ozone containing oxidation process is carried out to treat the metal oxide layer following the formation of the metal oxide layer.

Yu teaches that an ozone containing oxidation process is carried out to treat the metal oxide layer (high-k layer) following the formation of the metal oxide layer. Col.2 lines 27-47 and col.5 lines 1-17.

It would have been obvious to one of ordinary skill in the art to perform an ozone containing oxidation process to treat the metal oxide layer following the formation of the metal oxide layer as taught by Yu et al. in order to eliminating crystallization, reduce the required thickness to achieve an equivalent SiO<sub>2</sub> thickness. Col.5 lines 6-17.

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Paton et al. in view of Gardner and further in view of Yu et al. (US 6,573,193).

The combination of Paton et al. and Gardner teaches all the limitations of claim 9 as shown above. However, this combination does not explicitly teach that an ozone containing oxidation process is carried out to treat the metal oxide layer following

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the formation of the metal oxide layer.

Yu teaches that an ozone containing oxidation process is carried out to treat the metal oxide layer (high-k layer) following the formation of the metal oxide layer. Col.2 lines 27-47 and col.5 lines 1-17.

It would have been obvious to one of ordinary skill in the art to perform an ozone containing oxidation process to treat the metal oxide layer following the formation of the metal oxide layer as taught by Yu et al. in order to eliminating crystallization, reduce the required thickness to achieve an equivalent SiO<sub>2</sub> thickness. Col.5 lines 6-17.

### ***Response to Arguments***

2. Applicant's arguments with respect to claims 1 and 5-12 have been considered but are moot in view of the new ground(s) of rejection.

### **Conclusion**

3. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

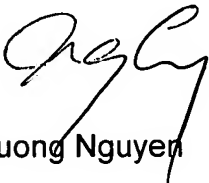
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extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

4. Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 872-9306. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

5. Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to CUONG Q NGUYEN whose telephone number is (571) 272-1661. The Examiner is in the Office generally between the hours of 6:30 AM to 5:00 PM (Eastern Standard Time) Monday through Thursday.

6. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Eddie Lee who can be reached on (571) 272-1732.



Cuong Nguyen

Primary examiner

9/29/05